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**U1S** S1206 S1699 S1700 S1706 S1707 S1739

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**EP 1118452 A** **EP 0736374 A**  
**EP 0559189 A** **US 4705719 A**  
**WPI Abstract: Acc. No.1993-140082 & JP050077383**

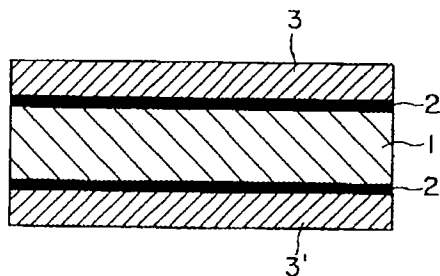
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(54) Abstract Title  
**Decorative laminate comprising synthetic paper**

(57) A laminate comprises a central substrate layer 1, with a synthetic paper layer 3 attached to each face by adhesive 2. The central substrate may comprise a polyolefin resin, a filler (example  $\text{CaCO}_3$ ) and other additives (examples UV absorbent, flame retardant) and may be roughened (examples corona discharge, acid treatment) to improve adhesion to the synthetic paper layers. The paper layers may comprise a polyolefin resin, a filler (example  $\text{CaCO}_3$ ) and titanium dioxide.

The laminate is stated to be usable with adhesives, to be readily printable and to be warp resistant and therefore to be useful amongst other things as a substrate for ceiling tiles, floor tiles, wall panels and decorative facings for furniture.

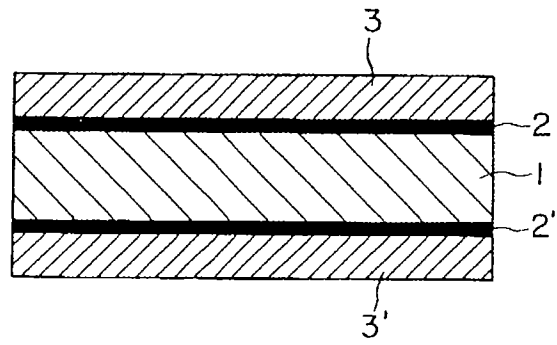
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## SHEET OF A THERMOPLASTIC RESIN SUITED FOR DECORATION

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

The present invention relates to a sheet of a thermoplastic resin suited for decoration. More particularly, the present invention relates to a sheet of a thermoplastic resin suited for decoration which exhibits excellent adhesion with adhesives and an excellent printing property, suppresses formation of warp and deformation and is advantageously used for substrates of decorative boards such as floor tiles and wall panels and substrates of decorative sheets which are attached to various furnitures and interior decorative materials of buildings for decoration or surface protection.

## 2. Description of Related Art

As substrate sheets of floor tiles and wall panels, heretofore, substrate sheets made of polyvinyl chloride resins have preferably been used due to flexibility of a suitable degree and excellent workability.

As the surface decorative boards for furnitures and cabinets in kitchens, in general, boards having a structure composed of a wood material, an inorganic material or a metal material such as a steel plate and a decorative sheet having a print such as a print of a wood pattern laminated together with an adhesive have been used.

For the decorative sheet used for the above surface decorative boards, heretofore, substrate sheets made of polyvinyl chloride resins have preferably been used due to flexibility of a suitable degree and excellent

workability such as the workability in V-cutting and workability in lapping.

However, the decorative boards and the decorative sheets made of polyvinyl chloride resins have problems in that durability (resistance to wear, scratch and formation of depression) and the cleaning property are poor, that environmental pollution arises due to generation of hazardous chlorine and dioxins during incineration and that the appearance becomes poor due to the tendency of plasticizers contained therein to bleed out.

Therefore, it has been desired that a decorative board and decorative sheet exhibiting excellent workability, durability and cleaning property is developed without using polyvinyl chloride resins.

Recently, many decorative boards and decorative sheets in which polyolefin resins are used for substrate sheets have been developed.

However, since the polyolefin resins, in general, have a poor adhesive property, a problem arises in that, when floor tiles and wall panels using polyolefins resins as backers are stuck to the surface of a floor and a wall with an adhesive, the floor tiles and wall panels tend to be cleaved from the surface of the floor and the wall.

On the other hand, due to the recent preference of consumers toward high grades, feeling of a high grade is required for floor tiles, wall panels, furnitures and cabinets in kitchens. Naturally, it is desired that decorative boards and decorative sheet used for such articles have appearance of a higher grade. Therefore, the surface of substrate sheets of polyolefin resins is printed with various patterns or laminated with films having patterns. However, polyolefin resins have a problem in that, in general, the printing property is poor and that, when substrate sheets of

polyolefin resins are laminated with various films with an adhesive, adhesion with the adhesive is poor.

To overcome the above problems, in general, the adhesion with adhesives and the printing property are improved by treating the surface of the substrate sheet of polyolefin resins by a physical or chemical treatment such as the treatment with corona discharge, the treatment by sand blast and the treatment with chromic acid or by lamination of a primer layer to the surface of the substrate sheet. However, the improvement in the adhesion with adhesives and the printing property in accordance with the above treatments is not always satisfactory although the improvement can be found to some degree.

#### SUMMARY OF THE INVENTION

The present invention has an object of providing a sheet of a thermoplastic resin suited for decoration which exhibits excellent adhesion with adhesives and an excellent printing property, suppresses formation of warp and deformation and is advantageously used for substrates of decorative boards such as floor tiles and wall panels and substrates of decorative sheets which are attached to various furnitures and interior decorative materials of buildings for decoration or for surface protection.

In the intensive studies by the present inventor to develop a sheet of a thermoplastic resin suited for decoration which exhibits the above excellent properties, the attention was paid on the fact that synthetic paper of a thermoplastic resin exhibits excellent adhesion with adhesives and an excellent printing property and, as the result of the studies, it was found that a laminate sheet comprising a substrate sheet of a

thermoplastic resin such as a polyolefin resin and the above synthetic paper of a film form disposed on both faces of the substrate sheet is suited to achieve the object. The present invention has been completed based on the knowledge.

The present invention provides:

- (1) A sheet of a thermoplastic resin suited for decoration which comprises a laminate comprising a substrate sheet and synthetic paper of a thermoplastic resin of a film form disposed on both faces of the substrate sheet;
- (2) A sheet of a thermoplastic resin suited for decoration described in (1), wherein the substrate sheet comprises a polyolefin resin;
- (3) A sheet of a thermoplastic resin suited for decoration described in any of (1) and (2), wherein the synthetic paper of a thermoplastic resin of a film form is synthetic paper comprising a polyolefin resin;
- (4) A sheet of a thermoplastic resin suited for decoration described in any of (1), (2) and (3), wherein the substrate sheet has a thickness in a range of 0.08 to 10 mm;
- (5) A parting strip suited for decoration on both faces which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of (1), (2), (3) and (4);
- (6) A display board suited for decoration on one or both faces which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of (1), (2), (3) and (4);
- (7) A wallboard suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of (1), (2), (3) and (4);

- (8) A ceiling suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of (1), (2), (3) and (4);
- (9) A floor material suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of (1), (2), (3) and (4); and
- (10) A baseboard suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of (1), (2), (3) and (4).

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a sectional view of an embodiment of the sheet of a thermoplastic resin suited for decoration of the present invention.

The numbers in Figure 1 have the following meanings:

- 1:                A substrate sheet
- 2 and 2':        Adhesive layers
- 3 and 3':        Sheets of synthetic paper of a thermoplastic resin of a film form

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the substrate sheet in the sheet of a thermoplastic resin of the present invention, a thermoplastic resin is used as the resin component. Examples of the thermoplastic resin include polyolefin resins, polyester resins and acrylic resins. Among these resins, polyolefin resins are preferable.

The polyolefin resin is not particularly limited. Examples of the

polyolefin resin include homopolymers and copolymers of  $\alpha$ -olefins such as ethylene, propylene, butene-1, 3-methylbutene-1, 3-methylpentene-1 and 4-methylpentene-1 and copolymers of  $\alpha$ -olefins with other copolymerizable unsaturated monomers. Specific examples include polyethylenes such as high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, ultra-high molecular weight polyethylene, ethylene-vinyl acetate copolymers and ethylene-ethyl acrylate copolymers; polypropylenes such as homopolymers of propylene, ethylene-propylene block copolymers and random copolymers and propylene-ethylene-diene compound copolymers; polybutene-1; and poly-4-methylpentene-1.

Among the above polypropylenes, crystalline polypropylene resins are preferably used. Examples of the crystalline polypropylene resin include crystalline isotactic homopolymers of propylene; ethylene-propylene random copolymers containing the ethylene unit in a small amount; block copolymers of propylene constituted with a homopolymer portion comprising a homopolymer of propylene and a copolymer portion comprising a copolymer of ethylene and propylene containing the ethylene unit in a relatively great amount; and crystalline propylene-ethylene- $\alpha$ -olefin copolymers which have a similar structure to that of the above block copolymers of propylene except that the homopolymer portion and the copolymer portion contain the unit of the copolymerized  $\alpha$ -olefin such as butene-1.

The polyolefin resin may be used singly or in combination of two or more. A recycled material can also be used. The polyolefin resin can be suitably selected in accordance with the application of the sheet of a

thermoplastic resin.

The substrate sheet may also comprise inorganic fillers, where desired. The content of the inorganic filler is not particularly limited and can be suitably selected in accordance with the application of the sheet of a thermoplastic resin. The content is, in general, in the range of 20 to 85% by weight and preferably in the range of 30 to 75% by weight. When the content is smaller than 20% by weight, workability in cutting and rigidity are insufficient. When the content exceeds 85% by weight, the molding property to prepare sheets and impact strength deteriorate and the weight increases. Therefore, contents outside the above range are not preferable. Examples of the inorganic filler include calcium carbonate, magnesium carbonate, aluminum hydroxide, magnesium hydroxide, kaolin, silica, perlite, calcium sulfate, barium sulfate, calcined alumina, calcium silicate, talc and mica. The inorganic filler may be used singly or in combination of two or more.

Among the above inorganic fillers, calcium carbonate, talc, aluminum hydroxide and magnesium hydroxide are preferable and calcium carbonate is more preferable from the standpoint of workability in cutting and economy. Calcium carbonate is not particularly limited and any of precipitated calcium carbonate and ground calcium carbonate can be used. The average particle diameter of calcium carbonate is, in general, in the range of 0.05 to 200  $\mu\text{m}$  and preferably in the range of 0.5 to 20  $\mu\text{m}$ .

The substrate sheet may suitably comprise various other additive components such as antioxidants, heat stabilizers, ultraviolet light absorbents, photostabilizers, chlorine scavengers, flame retardants,

auxiliary flame retardants, lubricants, mold releases, coloring agents, softening agents such as plasticizers, process oils and liquid paraffin, other thermoplastic resins and thermoplastic elastomers, where desired.

To prepare the substrate sheet, a thermoplastic resin such as the polyolefin resin described above, an inorganic filler such as calcium carbonate preferably in an amount of 20 to 85% by weight of the total amount of the molding material and various additive components used where desired are mixed together by a tumbler blender or a Henschel mixer. The material obtained by the mixing may further be melt mixed by a single screw extruder or a multi-screw extruder and formed into pellets. Thus, a molding material for the substrate sheet is prepared. The molding material is processed in accordance with a conventional molding process such as the cast molding process, the extrusion sheet molding process and the calender molding process and the substrate sheet is prepared. The molding material may be foamed in an extruder so that a foamed substrate sheet having a suitable degree of foaming is prepared. The thickness of the substrate sheet is suitably selected in accordance with the application of the sheet of the thermoplastic resin, in general, in the range of 0.08 to 10 mm and preferably in the range of 0.1 to 6 mm.

In the present invention, where desired, the substrate sheet thus obtained can be subjected to a physical or chemical surface treatment such as the oxidation treatment and the formation of a rough surface so that adhesion with synthetic paper which will be disposed on both faces of the substrate sheet is improved. Examples of the oxidation treatment include the treatment with corona discharge, the treatment with chromic acid, the treatment with flame, the treatment with heat air and the treatment with

ozone under irradiation with ultraviolet light. Examples of the formation of a rough surface include the treatment by sand blast and the treatment with a solvent. The surface treatment can be suitably selected in accordance with the type of the substrate sheet. In general, the treatment with corona discharge is preferable from the standpoint of the effect and operability.

The sheet of a thermoplastic resin of the present invention comprises synthetic paper of a thermoplastic resin of a film form which is disposed on both faces of the substrate sheet prepared as described above. The synthetic paper of a thermoplastic resin has the surface formed like paper by using a combination of a thermoplastic resin and an inorganic filler. The synthetic paper exhibits a very excellent adhesive property with adhesives and printing property. As the synthetic paper, synthetic paper of polyolefin resins, synthetic paper of polystyrene resins, synthetic paper of polyvinyl chloride resins and synthetic paper of polyester resins are known. In the present invention, synthetic paper of polyolefin resins is preferably used.

The synthetic paper of a polyolefin resin is prepared by adding calcium carbonate and titanium oxide in a total amount of about 5 to 30% by weight based on the total amount by weight to polypropylene or polyethylene, followed by forming the obtained mixture into a film. In the present invention, synthetic paper of a film form having a thickness of about 50 to 150  $\mu\text{m}$  is used.

When synthetic paper of a film form is laminated to both faces of the substrate sheet, it is preferable that an adhesive layer is disposed between the substrate sheet and synthetic paper and the substrate sheet and

synthetic paper is laminated via the adhesive layer since, when the lamination is conducted in accordance with the heat lamination, there is the possibility that the adhesion with the substrate sheet is insufficient.

Preferable examples of the adhesive layer include adhesive layers which are composed of films having the same properties as those of the substrate sheet or conventional adhesives exhibiting the adhesive property under heating such as adhesives comprising chlorinated polyolefin resins, polyurethane resins, epoxy resins, acrylic resins, vinyl resins, vinyl acetate resins, polyester resins, ethylene-vinyl acetate copolymer resins, acrylic monomer-vinyl acetate copolymer resins, polyamide resins or ionomer resins as the main components. It is preferable that the adhesive layer has a thickness of about 1 to 20  $\mu\text{m}$ .

When a film having the same properties as those of the substrate sheet is used for the adhesive layer, it is advantageous that the film is stuck to the surface of the synthetic paper used for the lamination in advance via an adhesive such as a urethane adhesive or an acrylic adhesive. The synthetic paper can be heat sealed to the substrate sheet by treating the synthetic paper in this manner in advance.

The two sheets of synthetic paper laminated to the faces of the substrate sheet may be the same with or different from each other and may have the same thickness or different thicknesses. From the standpoint of preventing formation of warp and deformation of the obtained sheet of the thermoplastic resin and productivity, it is advantageous that the sheets of synthetic paper are the same and have the same thickness.

The sheet of a thermoplastic resin of the present invention thus

obtained exhibits very excellent adhesion with adhesives and printing property and can suppress formation of warp and deformation. The sheet of the thermoplastic resin is advantageously used, for example, as a substrate of decorative boards such as floor tiles and wall panels and a substrate of decorative sheets used for decorative face boards of various furnitures, cabinets in kitchens and interior decorative materials of buildings.

Figure 1 shows a sectional view of an embodiment of the sheet of a thermoplastic resin suited for decoration of the present invention. The sheet has a structure in which sheets of synthetic paper of a thermoplastic resins of a film form 3 and 3' are laminated to the faces of a substrate sheet 1 via adhesive layers 2 and 2'.

The sheet of a thermoplastic resin of the present invention can be used for preparing decorative boards such as floor tiles and wall panels and decorative sheets used for decorative face boards of various furnitures, cabinets in kitchens and interior decorative materials of buildings. For example, a layer having patterns such as wood patterns, stone patterns, surface patterns of leather, cloth patterns or abstract patterns may be formed on one of the sheets of synthetic paper in accordance with a conventional printing process such as the gravure printing process, the screen printing process, the offset printing process and the flexography. A clear coating layer may be formed on the layer having the patterns. Various laminating materials may also be laminated. Examples of the laminating material include metal sheets, transparent or colored plastic sheets, transparent plastic films having patterns, transfer films, scratch resistant clear films, kraft paper, printing paper, non-woven fabrics and

woven fabrics.

Alternatively, the synthetic paper of a thermoplastic resin of a film form may be printed with the above patterns on the surface in advance. Then, the synthetic paper printed with the patterns and synthetic paper having no patterns are laminated to the faces of the substrate sheet.

When the decorative board obtained as described above is attached to a face of an object such as a floor face or a wall face, it is sufficient that the decorative board is stuck to the object via an adhesive in a manner such that the back face of the board faces to the face of the object. The decorative board can be firmly stuck to the object.

A decorative face board of a furniture, a cabinet in a kitchen and an interior material for a building can be prepared by adhering the decorative sheet to a wood substrate such as a wood, a plywood, a laminated wood, a particle board and a hard board, a metal substrate such as a steel plate, a stainless steel plate and an aluminum plate or an inorganic substrate such as a gypsum board via an adhesive in a manner such that back face of the decorative sheet faces to the substrate.

The sheet of a thermoplastic resin suited for decoration of the present invention can be advantageously used for printed decorative boards such as boards for furnitures, parting strips such as parting panels, blind boards, display boards such as boards for posters, cabinets, boxes, wallboards, ceilings, name plates, floor materials and base boards.

To summarize the advantages of the present invention, the sheet of a thermoplastic resin suited for decoration of the present invention exhibits excellent adhesion with adhesives and an excellent printing property, suppresses formation of warp and deformation and is

advantageously used for substrates for decorative boards such as floor tiles and wall panels and substrates for decorative sheets which are attached to various furnitures, cabinets in kitchens and interior decorative materials of buildings for decoration or for surface protection.

## EXAMPLES

The present invention will be described more specifically with reference to examples in the following. However, the present invention is not limited to the examples.

### Example 1

#### (1) Preparation of a substrate sheet

A homopolypropylene [the weight-average molecular weight: about 320,000; the melt index (MI): 3.1 g/10 minutes] in an amount of 45 parts by weight, 55 parts by weight of powder of calcium carbonate having an average particle diameter of 1.0  $\mu\text{m}$  and 0.2 parts by weight of a hindered phenol antioxidant were dry blended and the resultant mixture was melt mixed by a twin-screw extruder. A substrate sheet having a thickness of 3.0 mm was prepared in accordance with the extrusion molding process.

Then, both faces of the substrate sheet were subjected to the treatment by corona discharge in accordance with a conventional process.

#### (2) Preparation of a sheet of a thermoplastic resin

On one face of synthetic paper having a thickness of 100  $\mu\text{m}$ , which was a film prepared from a compound obtained by mixing calcium carbonate and titanium oxide into a high density polyethylene, an adhesive layer which comprised a chlorinated polypropylene resin and had

a thickness of 3  $\mu\text{m}$  was formed.

On both faces of the substrate sheet obtained in (1) described above, the synthetic paper prepared above was laminated by heat sealing in accordance with the pressing process at a temperature of 150°C in a manner such that the adhesive layer comprising the chlorinated polypropylene contacted the substrate sheet and a substrate for a wallboard having the structure shown in Figure 1 was prepared.

<Evaluation of warp>

A sample of 100 cm long and 100 cm wide was cut out from the substrate prepared above and placed on a flat glass plate. The height was measured at eight points, i.e., four corners and the central points between the corners. Then, the sample was placed upside down and the same measurement was made. As the result of the measurements, the maximum warp was found to be 2 mm.

<Evaluation of adhesion with an adhesive>

A sample having a size of 20 mm $\times$ 20 mm was cut out from the substrate. The sample was adhered to a steel plate with a urethane adhesive and the combined sample was left standing for 7 days. Then, a planar tensile test was conducted. The cohesive fracture of the adhesive took place at a tensile force of 0.62 N/mm<sup>2</sup>.

<Evaluation of the printing property>

In an area of 1 cm<sup>2</sup>, a grid having 100 elements each having an area of 1 mm<sup>2</sup> was formed. A peeling test using a cellophane tape was conducted. The number of elements which were not peeled was used for evaluation of the adhesive property of the print. The number of peeled element was found to be zero and the printing property was excellent.

### Comparative Example 1

A substrate for a wall panel was prepared in accordance with the same procedures as those conducted in Example 1 except that the synthetic paper was laminated to one face of the substrate sheet alone.

The warp of the substrate for a wall panel was evaluated in accordance with the same method as that conducted in Example 1. The adhesion with an adhesive and the printing property on the face not laminated with the synthetic paper were evaluated in accordance with the same methods as those conducted in Example 1.

As the result, the maximum warp was 5 mm and the cohesive fracture of the adhesive took place at a tensile force of 0.36 N/mm<sup>2</sup>. The printing property was poor (the number of peeled elements: 12).

### Example 2

#### (1) Preparation of a substrate sheet

An ethylene-vinyl acetate copolymer resin [the unit of ethylene: 90% by weight; the weight-average molecular weight: about 110,000; MI: 3.0 g/10 minutes] in an amount of 65 parts by weight, 225 parts by weight of powder of calcium carbonate having an average particle diameter of 2.4  $\mu\text{m}$ , 5 parts by weight of diisononyl phthalate as the plasticizer, 2.5 parts by weight of zinc stearate as the lubricant, 2.5 parts by weight of an ester of phosphoric acid as the release agent from metal rolls and 0.5 parts by weight of a hindered phenol antioxidant were dry blended. A substrate sheet having a thickness of 3.0 mm was prepared in accordance with the sheet molding process.

Then, both faces of the substrate sheet were subjected to the treatment by corona discharge in accordance with a conventional process.

(2) Preparation of a sheet of a thermoplastic resin

A synthetic paper was laminated on both faces of the substrate sheet prepared in (1) described above and a substrate for floor tiles was prepared in accordance with the same procedures as those conducted in Example 1 (2).

The warp and the printing property of the substrate for floor tiles were evaluated in accordance with the same methods as those conducted in Example 1. The adhesion with an adhesive was evaluated in accordance with the method described in the following. As the result, the maximum warp was 2 mm, the printing property was excellent (the number of peeled element: zero) and the adhesive strength was 11.1 kg/50 mm.

<Evaluation of adhesion with an adhesive>

A flexible board having a thickness of 3.0 mm was coated with a urethane adhesive and specific cuts were formed on the coated layer by a comb. The substrate for floor tiles which was cut to a width of 50 mm was pressed against the layer of the adhesive by a roller. After 4 days, the 90 degree peeling test of the sample was conducted.

Comparative Example 2

A substrate for floor tiles was prepared in accordance with the same procedures as those conducted in Example 2 except that the synthetic paper was laminated to one face of the substrate sheet alone.

The warp of the substrate for floor tiles was evaluated in accordance with the same method as that conducted in Example 2. The adhesion

with an adhesive and the printing property on the face not laminated with the synthetic paper were evaluated in accordance with the same methods as those conducted in Example 2.

As the result, the maximum warp was 5 mm and the adhesive strength was 0.5 kg/50 mm. The printing property was poor (the number of peeled elements: 15).

## CLAIMS

1. A sheet of a thermoplastic resin suited for decoration which comprises a laminate comprising a substrate sheet and synthetic paper of a thermoplastic resin of a film form disposed on both faces of the substrate sheet.
2. A sheet of a thermoplastic resin suited for decoration according to Claim 1, wherein the substrate sheet comprises a polyolefin resin.
3. A sheet of a thermoplastic resin suited for decoration according to any of Claims 1 and 2, wherein the synthetic paper of a thermoplastic resin of a film form is synthetic paper comprising a polyolefin resin.
4. A sheet of a thermoplastic resin suited for decoration according to any of Claims 1, 2 and 3, wherein the substrate sheet has a thickness in a range of 0.08 to 10 mm.
5. A parting strip suited for decoration on both faces which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of Claims 1, 2, 3 and 4.
6. A display board suited for decoration on one or both faces which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of Claims 1, 2, 3 and 4.

7. A wallboard suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of Claims 1, 2, 3 and 4.

8. A ceiling suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of Claims 1, 2, 3 and 4.

9. A floor material suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of Claims 1, 2, 3 and 4.

10. A baseboard suited for decoration on one face which comprises a sheet of a thermoplastic resin suited for decoration which is described in any of Claims 1, 2, 3 and 4.



INVESTOR IN PEOPLE

Application No: GB 0116025.8  
Claims searched: 1-10

Examiner: Richard Gregson  
Date of search: 10 December 2001

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.5): B5N

Int Cl (Ed.7): B32B (27/00, 27/06, 27/08, 27/10, 27/16, 27/18, 27/20, 27/22, 27/28, 27/32)

Other: Online: EPODOC, WPI, JAPIO, RM25

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP 1118452 A (NAN YA) - see abstract and page 2, line 41 to page 3 line 31 in particular.	1-3
X	EP 0736374 A (OJIYUKA) - see page 3, line 53 to page 4, line 10 in particular.	1-3
X,Y	EP 0559189 A (OJIYUKA) - see page 2, line 41 to page 3 line 22 in particular.	X: 1-4, 6 Y: 9
X	US 4705719 A (YAMANAKA et al.) - see abstract in particular.	1-3
Y	WPI Abstract: Acc. No. 1993-140082 & JP 5077383 (LONSEAL) - see diagrams and English language abstracts.	9

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.